Discharge initiation by ICRF antenna in IShTAR

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IShTAR (Ion cyclotron Sheath Test ARangement) is a linear magnetized plasma test facility dedicated to the investigation of RF wave/plasma interaction [1]. The IShTAR ICRF system consists of a single strap RF antenna designed to operate in a wide frequency range with a generator power up to 1kW. When using the antenna for plasma production without an external plasma source, it is shown that the plasma is either produced in front of the antenna strap or inside the antenna box depending on the antenna parameters.

Here, we present experimental and numerical investigation of the plasma initiation parametric dependency. This study aims at better understanding how ICRH&CD systems can be safely employed for plasma production especially relevant for ICWC generation [2]. We investigate for which conditions the plasma is initiated inside the antenna box, as it is essential to avoid such phenomenon. In contrast to the high power ICRF system on tokamak, IShTAR provides liberty for detailed investigations of these phenomena.

Detailed parameter scans were performed in helium at f=5.22MHz and f=42.06MHz for the neutral gas pressure, generator power and magnetic field at IShTAR device. The experiment shows the parameter ranges for which the plasma is produced in front of the strap, or in the antenna box. The experimental dependencies on the parameters are validated by simulations with the RFdinity model, and by theoretical predictions [3].

The model used in our study (RFdinity) traces the motion of electrons in a narrow bundle of magnetic field lines close to the antenna strap [4]. The charged particles are accelerated in the parallel direction with respect to the magnetic field B_T. Depending on the antenna parameters (generator power, frequency, and shape of the antenna electric field), electrons can be trapped in a potential well of the antenna field. These trapped electrons are accelerated and depending on the neutral gas pressure may collide causing ionization of the neutral gas.

[1] K. Crombé et. al., AIP Conf. Proc. 1689, doi: 10/1063/1.4936471 (2015)
[2] T. Wauters et. al., J. Nucl. Mater. 463, doi: 10.1016 (2015)
[3] A. Lyssoivan et al., Plasma Phys. Control. Fusion 54, (2012)
[4] M. Tripsky et al., European Conference Abstracts (ECA), 2014, vol. 38F.

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